ENGINEERING NEWS.

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GEO. H. FROST, PROPRIETOR.

SATURDAY, MARCH 19, 1881.

AN important decision for contractors was recently rendered by Judge Treat, of the United States Circuit Court for the Southern District of Illinois, in the case of E. G. Burkam & Company against Cox & Company, which has been pending for many months, that contracts for the future purchase or sale of goods are legal and binding contracts. The judge instructed the jury to return a verdict for the plaintiffs' claim in full.

THE variation between engineering estimates and contractors' bids is sometimes very great, but the margin on the opening of contracts for the Buffalo connecting sewers is altogether exceptional. The engineer estimated the cost at one million at the highest. The contracts were as follows:

John A. Holloway	$1,568,000
C. E. Williams	1,616,352
J. W. Dennis	1,736,000
J. O. Smith	1,800,000
George Talbot	1,851,300
E. D. Delamater (Cleveland, Ohio)	1,657,300

THE French government recently tendered the United States an invitation to be represented in an International Congress of Electricity, to be held at Paris on the 15th of September next, and also to send an American Commission to the proposed International Electrical Exhibition of Paris, to open on August 1, 1881, and close on the 15th of November following. As no action was taken by the last congress in regard to this proposition the Secretary of State is now considering the feasibility of organizing a volunteer commission to represent the United States, and to that end he has applied for and obtained an extension of the time fixed for receiving applications from American inventors until the 15th of May. Forms of application, in French, can be obtained from the State Department, which will, for the present, take charge of any applications that may be sent to it. The exhibition will embrace all inventions, and applications of electricity to science, art, manufactures navigation, telegraphy and commerce. Exhibitors delivering their exhibits at the palace of the Champs Elysées, in Paris, will be given space gratis, but the installation of their exhibits will be at their own expense. Motive power will be furnished at a reasonable cost. Inventions not patented in France may be protected under the French law of 1868 by filing due application with the Prefect of the Seine, at Paris, at any time before the 31st of August.

MOVING THE OBELISK.

On the evening of the 15th Lieutenant-Commander Henry H. Gorringe, U. S. N., read a paper before the American Society of Civil Engineers in Chickering Hall on the removal of the obelisk from Alexandria to this city. The audience was a very large one. Upon the platform were Mr. James B. Francis, the President of the Society; Messrs. O. Chanute, Ashbel Welch, John Bogart, J. J. R. Croes, Chief Justice Daly, President of the Geographical Society; Col. Wm. H. Paine, C. V. Smith, Joseph P. Davis, W. Cargill, J. W. Adams, E. S. Chesbrough, Gen. Geo. S. Greene, C. H. Haswell, W. E. Worthen, A. P. Boller, D. V. Wood, S. H. Shreve, Geo. W. Dresser, C. E. Emery, S. H. Smedley, F. C. Prindle, E. S. Bowen, F. M. Kelley, Judge Edwards Pierrepont, N. M. Beckwith, F. K. Hain, School Commissioner Wood, Park Commissioner Stebbins, and several others.

Lieutenant-Commander Gorringe came upon the platform at eight o'clock precisely, and was briefly introduced by the President of the Society. After the applause which greeted him had subsided, he said:

"On glancing over this large audience it is very evident to me that the Society of Civil Engineers is composed largely of women. (Laughter and applause.) As my paper deals necessarily largely in technical terms I fear that they may find it somewhat tiresome, but I have tried to avoid technicalities as much as possible and trust that I shall not weary you.

"The moving of obelisks is not a novel undertaking even in modern times, for one larger and one smaller than ours have been successfully removed from Egypt to Europe in this century; but there was one novel feature involved in my work. From Egypt to the mouths of the Tiber, Thames and Seine it is not necessary to lose sight of land, and safe harbors are available at short intervals, but in a voyage from Egypt to America there is one stretch of nearly 3,000 miles, where rough seas are invariably encountered in every season. The vessel that was to bring our shaft across the Atlantic must have its own motive power, for it would have been impracticable to tow it across, and in the formation of my plans everything was secondary to the successful embarkation of the obelisk in such a vessel in Alexandria. Until I reached England on my way to Alexandria, I had been under the impression that the English iron cylinder had proved unseaworthy, but while seeking insurance in London I was informed by representatives of the best companies that they would not take the marine risk on our obelisk unless I adopted the English method of sea transportation. Two curious propositions were made to me in this country—one to bring the shaft over on the deck of a sailing vessel of 400 tons, the other that I should sling it under her keel. The idea of putting it inside of the hold and stowing it as you would any other article appeared to amuse every ship-owner that I applied to for a vessel, and I was obliged finally to purchase a steamer after six months of fruitless effort to charter one. Although the French plan of lowering had been eminently successful, it did not satisfy me. There were too many tackles and too much division of responsibility at the critical moment. There was, however, one marked advantage: the greatest strain on the apparatus was at the moment of the least danger to the obelisk—when it was nearly horizontal. The essential features of this plan were a hinge at the heel of the shaft for it to turn on, and a system of revolving shears with tackles to suspend the upper end of the shaft and lower it to a horizontal position. It combines the turning and lowering to the ground in one movement, and this was another advantage. It has been claimed by the English that my plan for turning over and lowering is identical with theirs. The only similarity is the suspension of both shafts at their centers of gravity. If the English engineer originated this plan for facility of handling heavy masses he must have lived several centuries; cannon, among other things, have always been mounted in this manner. The fact is, my method of turning the obelisk from its erect position to the horizontal was very naturally suggested by the associations of my profession. Here is the structure I designed, and here is that used for turning the English obelisk. Mine is simply a steel gun-carriage, with the running in and out and training attachments omitted; the English is a heavy timber structure bearing, as you can not fail to notice, a striking resemblance to that used by the Roman engineer Fontana in the sixteenth century. It would be as near the truth to assert that the Roman engineer had copied from the English as it is to claim that I had done so. Uncertainty as to the strength of syenite necessitated providing against the possibility of the shafts breaking through the middle when their whole weights were suspended at their centers of gravity. The Englishman encased his in a wrought iron jacket riveted around it for one-third of its length, and drove in hard wood wedges between it and the stone. We trussed the obelisk by supporting the ends with steel wire ropes passed over an upright, standing on the center of gravity. The Englishmen suspended the shaft at its center of gravity on angular projections riveted to the wrought-iron jacket and extending out at right angles to its axis. We clasped the stone between cast-iron trunnions held together by steel bolts. The trunnion plates were provided with lips to keep the obelisk from slipping through while it was horizontal. While the shaft was in a vertical position the bolts that held the trunnions together could be slackened without risk to allow the obelisk to be raised or lowered by means of the turn-buckles. The radical differences between my apparatus and that used in London are that mine is composed of adjustable parts needing only unskilled labor to put them together and of convenient sizes and forms for facility of handling and transport; the English was a permanent structure riveted around the obelisk. My apparatus permitted me to lift the shaft vertically until it was clear of its supports in Alexandria and land it squarely on its pedestal in New York in the exact position I wished it to stand; the English apparatus was limited in its functions to the simple turning of the obelisk; lifting it and lowering it in any position had to be done by hydraulic pumps, and adjusting it on the pedestal was impossible. There has been some question as to who designed the apparatus I used for turning the shaft, doubtless owing to the fact that I am only a naval officer and not an engineer. I anticipated this and made a rough sketch and memoranda on the day I decided on my plan. This original sketch, with date and signatures of witnesses, is now in my possession. I gave a copy of it to Mr. Charles Roebling, a name familiar to this Society, and deservedly eminent in engineering annals, who developed the plan, determined the strains, and with his own hands made a working drawing of it. He then took a contract for its construction and sublet it to the Phœnix Iron Works, of Trenton, where it was executed so admirably that every piece fitted to its place without the slightest trouble or need of adjustment after it reached Alexandria.

"The execution of plans differs from their formation in that the one requires money, while the other does not, and I experienced great difficulty in raising money to carry out my plans. We arrived in Alexandria on Oct. 16, 1879. Not the least of the difficulties I had anticipated was the hostility of the foreign element in Egypt to the removal of the obelisk. It rapidly developed to an extent never dreamed of. It was known that every tourist who wanted a piece of the obelisk could have it broken off by paying a few piastres to an Arab living near by who kept the ladders and the hammers all ready to satisfy the demand. It was known that, owing to the removal of two of its bronze supports and the gradual encroachment of the sea, the obelisk was slowly tipping over, and must inevitably fall on the adjacent ruins on the sea-shore, and probably break. It was known that the man who claimed the land on which it stood contemplated erecting a hotel or French-flat building around the obelisk, which was to adorn his courtyard. The Egyptians, the only ones who had a right to object to its removal, regarded it as an emblem of a religion antagonistic of their own, and its figures and hieroglyphs as relics of that which is most abhorrent to a Mahometan—idolatrous worship. They did not care who took it or where it went so long as it was removed. The foreign residents really cared nothing about its removal, but each nationality wanted it removed to their own country and all Europeans were opposed to its removal to America. This was the secret of their hostility. The first thing for us to do on reaching Alexandria was to get possession of the obelisk. The Governor at the command of the Khedive formally turned it over to us and preparations were immediately made for commencing the work of removal. When the workmen appeared on the ground to commence the excavation, the Italian Consul gave notice to our Consul that he would prevent us, by force if necessary, from doing any work on that ground. It appears that some years before the Khedive had granted to an Italian subject the privilege of erecting a bath-house on the seashore adjacent to the obelisk. This bath-house had been destroyed by a gale of wind and the Italian claimed compensation from the Egyptian government for his loss. By some means his claim had been referred to the International Tribunal, and it was evident that, however absurd it might be, I was obliged to treat with him. It then occurred to me that the best plan was to get absolute control of the property surrounding the obelisk by lease, which was finally accomplished after great difficulty. Finding that this obstacle had been removed, the foreign residents tried another plan to prevent my commencing work. A creditor of the Egyptian government got the courts to issue a writ to seize the obelisk in payment of his debt, and I was applied to as to the course I would pursue on the presentation of the writ. I gave an ambiguous answer, but purchased a supply of rifles and revolvers, hoisted the American flag and made preparations for a siege, for the obelisk then had been formally transferred to me as the representative of the American Government, and if the Egyptian Government could not protect me in my right I was bound to protect myself. This plan of

dealing with the difficulty was effective. The writ was never served and the work of removal went on uninterruptedly, but with no end of embarrassment from the same spirit of hostility. By some mysterious arrangement the foreign merchants of Alexandria have control of the streets, although they are exempt from taxation. Without their consent the obelisk could not be transported overland to the port, and as this consent could not be obtained I was obliged to throw away my apparatus for carrying out this part of my work and build, at great additional expense, a large caisson in which to float it around.

"Before I could sail from Alexandria it was necessary for me to provide a crew for the steamer and effect insurance on her, and both of them gave me great difficulty. Sailors are naturally superstitious, and this is intensified in the mariners of Eastern nationalities, from whom my crew must be recruited, and I was finally obliged to send to Trieste for the greater part of them, and I left Alexandria with eight nationalities on board. One of the conditions that had been made by my friends who had advanced the money to purchase the steamer was that they were to be secured against loss by covering the vessel and her cargo with insurance. Up to five days before our departure from Alexandria the lowest rate of premium that had been demanded was 10 per cent, but on its becoming evident that I would undertake the voyage without insurance rather than submit to such an imposition, the underwriters in London agreed to reasonable rates. One of the chief embarrassments about insurance and crew was the nationality of the vessel. She had been built in England for the Egyptian government, and used as a transport and mail steamer until I purchased her. It was impossible to make the voyage under Egyptian colors and I had determined not to make it under the English. In fact, the voyage was made practically without the protection of any nation, and had any one chosen to question my right to undertake it, there is no telling what would have resulted. I am indebted to the British military authorities in Gibraltar, the only port at which I touched, for a convenient obscurity of vision and lack of inquisitiveness in the examination of the ship's papers. The voyage was without incident excepting the breaking of our shaft, which was easily replaced, as a spare one had been provided before departure."

Commander Gorringe described the manner of removing the obelisk from the Dessoug to its site in Central Park, and in concluding his lecture said:

"The work of the removal of the French obelisk is the only parallel with that involved in the removal of ours. It occupied the French engineer nearly six years and cost the French Government nearly a half million of dollars to complete this work. The total time taken for the removal of our obelisk from the time we began the work in Alexandria until it was finally erected in the Park was one year and four months, and the cost was $105,000—if the money invested in the steamer is recovered from her sale, which has not yet been effected."

The lecture was illustrated by models of the obelisk and of the machinery used in taking it down, transporting and re-erecting it. There were also drawings of the methods used by the Romans, French and English in the moving of obelisks.

At the conclusion of the lecture, on motion of Mr. Ashbel Welch, a vice-president of the Society, seconded by Mr. O. Chanute, another vice-president, a vote of thanks was tendered to Lieutenant-Commander Gorringe. Some excellent stereopticon views were then exhibited, showing the obelisk in its original position at Alexandria and the various operations connected with its removal and embarkation, and these were briefly explained by Lieutenant-Commander Gorringe.

BROOKLYN UNDERGROUND RAILROAD.

A number of prominent business men of Brooklyn, owning property on Washington, Fulton, and other streets, have organized a company under the General Railroad Law, and the Tunnel Law of 1880, to construct a main line from Fulton Ferry to Flatbush, with a provision for suitable branches in other streets.

The example of London and New York in the matter of rapid transit, the rapid increase of population, the large summer travel to Coney Island, and the growing importance of Kings County and the main island, have given rise, within a few years, to various railway projects.

As between an elevated and depressed road, these gentlemen have concluded that the advantages are decidedly in favor of the latter, in relation to property interests, and as an investment. Experience in our courts of law, in cost of construction and in maintenance and operation, has somewhat dimmed the rose color of elevated roads as an investment, the chief profits being made by the originators.

The courts are gradually reducing them to the standing of other railways, as to taxation and property damages; and the damages they are apt to cause in daily operation must prove a growing expense. Structures composed of so many parts, held by rivets, and in constant vibration, already involve constant repair; fires along the line may entirely suspend travel for some time, and seriously injure the structure; the trains cannot be safely operated in fogs, and are in danger from high winds; switches and curves too short, from mistaken economy, increase risks, and require heavy and costly engines; the risks of accidents to passengers and employés are serious.

In the case of Brooklyn, a gravel formation, rising rapidly from tide—while elevated lines have great disadvantage in grade, so much so that the last plan proposes to elevate passenger cars by machinery to a proper starting level at the ferry—a tunnel line promises easy grades, immunity from various expenses and damages, and the special advantage, every engineer will recognize, of a permanent road-bed for maintenance and operation. The great improvement in compressing air will facilitate tunnel ventilation, and may be made available for motive power, and recent experiments have very clearly demonstrated the advantages of steam and air for locomotive use.

Under preliminary estimates, made by Samuel McElroy, C. E., who has built several large railway tunnels in this formation, the cost of the subway, with double track, will not probably exceed $400,000 per mile, and the entire cost for equipment, stations, damages, etc., will be much less than $1,000,000 a mile; or, as compared with New York roads, much less than they represent per mile.

Under the articles of association adopted March 10th, at a large meeting, Messrs. Henry Mumford, T. K. Horton, J. M. Leavitt, J. M. Balch, John French, S. B. Duryea, E. D. Berri, I. F. Cary, J. L. Nutting, B. T. Lynch, Edward Freel, Wm. Burdon, O. B. Baldwin and George Wilson were named as directors. Liberal subscriptions have been made to the stock.

The main line, as proposed, commences at the Fulton Ferry, passes near the City Hall, meets the Long Island Railroad at Atlantic and Flatbush avenues, and connects with various Kings County lines, near the city line, in Flatbush, on the east side of the Park; branch lines in Myrtle avenue and other streets are contemplated.

PERSONAL.

It has been proposed to hold a Stephenson Centenary on June 9, 1881.

Mr. William E. Hoyt of Boston, Mass., recently locating engineer on the New York, Chicago & St. Louis Railroad, has been appointed chief engineer of the Rochester & Pittsburgh Railroad, formerly the Rochester & State Line.

The Board of Public Works of Providence, L. I., created by the State Legislature, and organized November last, consists of the City Engineer and two commissioners who have charge of highways, water and sewers, the City Engineer acting as Superintendent of the Board.

The funeral of the late James W. Whittaker, Chief Engineer U. S. N., took place recently at Philadelphia, the large number attending included army and navy officers, members of the Loyal Legion and Post 2, G. A. R. The interment took place at Woodland Cemetery, West Philadelphia.

Mr. John J. Potts, Assoc. M. Inst. C. E. and formerly Secretary of the Liverpool Engineering Society, of Liverpool, England, arrived in New York a few days since and has gone west as far as Laporte, Ind., where he proposes visiting some friends. Mr. Potts is interested mostly in dock works, to which he will devote some study in this country before he returns to England.

On the 12th inst, the Commissioner of Public Works of this city appointed Mr. Benjamin S. Church Chief Engineer of the Department, vice Mr. John C. Campbell, resigned. Mr. Church declined the appointment, and the Commissioner appointed Mr. Isaac Newton. Mr. Newton comes to this duty with an excellent reputation and the highest professional recommendations, and, judging from his scientific acquirements and large practical experience, he will discharge the duties of his office in a manner satisfactory to the public.

Mr. E. S. Chesbrough, an engineer widely and most favorably known in the United States, has been appointed Consulting Engineer of the Department of Public Works.

About six months ago Mr. Clarence King, finding that his duties as Director of the Geological Survey of the United States engrossed his whole time, and deprived him of all opportunities for independent scientific investigation, tendered his resignation, but was prevailed upon by President Hayes to remain until the close of his administration. On Saturday last Mr. King presented his resignation to President Garfield, and it was accepted. The President appointed Major J. W. Powell as Director, in accordance with the recommendation of Mr. King. Major Powell is well and favorably known from his connection with the survey of the Rocky Mountain region, which was conducted under his personal supervision. He is a gentleman of high scientific attainments, and is a member of the National Academy of Sciences. For a number of years Major Powell has devoted much of his time to the study and discussion of ethnological subjects, and he is at present Chief of the Bureau of Ethnology of the Smithsonian Institution.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 103.)

SCHUYLKILL WORKS.

A district lying north of the old city and which was growing in population, made a contract with the city in 1826 for a supply from the Fairmount Works at rates 50 per cent. greater than those paid in the city. In 1843, after opposition from the city, separate works were built for the supply of this district; 37.75 miles of pipe had already been laid for the supply from Fairmount.

On the bank of the Schuylkill a forebay was built, 450 by 60 ft., into which the water passed through a sluiceway and thence to the pumps.

Two condensing beam engines with fly-wheels with vertical double-acting pumps under the steam cylinders, the pump valves being of brass, hinged and working on cast-iron faces, were erected and were in constant use for 24 years. A third engine was built in 1849. This was a double-acting condensing engine, with vertical cylinders connected to a nearly horizontal pump by a bell crank. The valves were of bell metal and hinged.

* Copyright 1881

The fourth engine, built in 1854, is a Cornish beam engine. The fifth, built in 1869, is a side lever Cornish. The sixth, built in 1872, is a compound "Simpson" engine, and the seventh, built in 1875-6, is an upright compound engine, with the cylinders placed side by side, with a double acting plunger pump underneath each. The fly-wheel is at the back, worked by beams which obtain motion from a cross head between cylinder and pump. The cylinders are 45 and 80 in. diameter, and the pump 30 in. diameter, all having 72 in. stroke.

The three first named of these engines are used up. The remaining four pumped on the average 12¼ million gallons per day in 1879. The duty obtained and cost of pumping will be given hereafter.

The district of Kensington, lying north of the old city on the Delaware River side, which had been since 1826 supplied from Fairmount, was transferred to the Schuylkill district in 1844, but in 1851 erected works for an independent supply from the Delaware River, consisting of two pumping engines; No. 1, a double-acting high-pressure engine with 30-in. cylinder of 72-in. stroke, working a vertical lever beam, to the other end of which is attached a horizontal pump of 18-in. diameter and 30 in. stroke. No. 2 is a condensing engine with a vertical 42-in. cylinder with 72-in. stroke. The piston rod is connected above with a beam operating a fly wheel, and below with a bell crank working a horizontal pump of 19¼-in. bore and 72-in. stroke.

These engines, which have always been expensive to operate and repair, are still in use, pumping now, however, only when the demand is greatest, most of the work being done by a Worthington engine, which was erected in 1871. The water supplied from this station is of poor quality, being drawn from a point within one mile of which three-fifths of the sewage of the city is discharged into the River, both above and below the works.

For Germantown, east of the Schuylkill, and north of the old city, works were built by a private company in 1851. The Toolpahockin Creek was dammed and water pumped by two high-pressure engines to a stand-pipe 225 feet high; they passed into the city's hands in 1866, and were abandoned in 1872.

For the Twenty-fourth Ward, on the west of the Schuylkill, works were built in 1855, consisting of a subsiding reservoir a short distance above Fairmount dam, 165 by 75 ft. and 16.5 ft. deep, supplied from the river, and from which the water was pumped into a stand-pipe to a height of 225 ft. by two Cornish Bull engines with 50-in. steam cylinders and 96-in. stroke, the pumps being of 17-in. diameter. These engines were overtaxed and became worn out by 1870, and the works were then abandoned. Chestnut Hill at the extreme northwest corner of the city, and east of the Schuylkill, was supplied by works built in 1860 by a private company, taking its water from a well and spring by two horizontal engines, working one double-acting 7-in. pump of 48-in. stroke, raising the water 125 ft. into a tank holding 40,000 gallons.

These works were purchased by the city in 1873, at which time they supplied from 76,740 to 153,480 gallons per day.

A Knowles pump was added in 1876. In 1879 the daily supply was 239,815 gallons and there were constant complaints of deficient supply, more from lack of boiler capacity than from deficiency of water or of pumping power.

For the supply of Roxborough and Germantown, in the northwestern district, and south of Chestnut Hill, a Cornish beam engine, of 2½ million gallons capacity, pumping under a head of 334 ft., was erected in 1869, and a Worthington engine of 5,000,000 capacity in 1872.

New works were built in 1870 for the supply of the Twenty-fourth Ward, at Belmont on the Schuylkill, a short distance above the old West Philadelphia works, and taking their place, containing three Worthington engines, pumping under a head of 212 ft.

Frankford, in the northeastern corner of the city, is supplied from the Delaware River by a Cramp engine of 9½ million gallons, and a Worthington Engine of 2½ million gallons capacity, pumping under 180 ft. static head.

There are, at this time, supplying the city five engines, of antiquated types, with nominal capacity of 25.7 million gallons, seven Worthington engines, with a capacity of 35,000,000 gallons; one Cornish of 2.5 million gallons; and two Cramp engines of 28.5 million gallons nominal capacity; and, also, turbines at Fairmount of a capacity of 36,000,000 gallons per day, when there is sufficient water.

The total pumping capacity, under conditions existing in 1879, was stated to be for continuous work, 71,886,960 gallons per day, and there was actually pumped, in one day, 72,616,000 gallons.

RESERVOIRS.

The first reservoir at Fairmount, 91 ft. above the lowest street grade, was built in 1815, and was 167 by 317 ft., and 12¼ ft. deep. This and five other adjacent basins built at various times up to 1836 are in earthwork, and are lined with brick. The lining was badly damaged by frost, and was repaired in 1861. Their joint capacity is 27 million gallons.

The reservoir built for the Schuylkill Works in 1844, of puddled earth embankment, faced with brick and holding 9.8 million gallons, broke away when first brought into use, was repaired and is still used. The water-level is 115 ft. above the river, and depth 17 ft.

Two brick-lined reservoirs of puddled banks 112 ft. above mean tide, and holding 9,284,000 gallons, were built in connection with the Delaware works They were 14 ft. deep, and their shallowness and the bad character of the water have caused much trouble. Lime was often thrown in to keep the water sweet.

A reservoir (Corinthian avenue), 16 ft. higher than those at Fairmount, was built in 1852, containing 20.3 million gallons, and supplied from the Fairmount and Schuylkill works. It never held over 11 ft. of water without leaking until 1860, when repairs were made which allowed 16 ft. to be put in. In 1861 it was raised so as to hold 27 ft. of water, at 125 ft. above the river. The reservoir still leaked a little until 1865, when the source was discovered and stopped. In 1866 the introduction of a supply from a 48-in. pipe, over the bank, dropping 9 ft. on the lining-wall, caused a slide of the wall, and part of the outside bank slid off at another place. It now is kept with 25 to 26 ft. depth of water.

The Roxborough reservoir, 375 ft. above tide, is 410 by 240 ft. and 12 ft. deep, holding 12,000,000 gallons. It was built 1865-9, by days' work, and is an earth-bank reservoir. The embankments are of disintegrated mica schist, and for prevention of leaks a clay lining is depended upon. When first filled for 6 ft. it leaked, and, after repairing, was filled a few feet more, and again leaked. After stopping that leak, leaks and repairs were reported in 1873 in this reservoir, in one at Belmont and one at Mt. Airy, which had been purchased from the Germantown Water Company and was always in bad condition. In 1874 it was paved with brick, grouted with cement.

In 1871 a reservoir for the Delaware works was built adjoining the old ones in earth, with slopes of 1½ to 1, lined with brick on edge, laid in cement. The bottom was paved with brick, flat. The embankments were built in 6 in. layers, rolled with grooved rollers. Two leaks appeared in 1872.

A large storage reservoir in East Park was begun in 1871, but is not yet finished.

The Wentz Farm Reservoir, for Frankford, finished in 1877, is 24 ft. deep, and holds 36 million gallons, with its water surface 168.4 ft. above tide. The banks, of micaceous sand, have inside slopes of 2 to 1, lined with clay puddle. Leaks were discovered in the bottom in 1879, caused by stakes through the puddle left by the engineers during construction.

A pipe aqueduct over the Wissahickon was built in 1870, after designs of F. Graff, consisted of two lines of 20-in. cast-iron pipes, with flange joints, forming the top chord of a span of 165 ft., trussed by wrought-iron links, and resting on piers of four Phœnix columns. The pipe is 100 ft. above the creek.

In 1868 a pumping main of 36 in. diameter was carried across the forebay at Fairmount in the same manner by Mr. Graff. In 1870 a submerged pipe was laid across the Schuylkill in 25 ft. of water, 963 ft. long. The pipe was made with Ward's flexible joint.

In February, 1875, one of the lines of pipe over the Wissahickon was destroyed by frost. In 1876 a siphon, to be used in place of this bridge, was constructed, the creek being crossed by pipe laid in an oak cradle and then submerged. The pipes at the bottom of the valley are under 295 ft. head. They are of 20 in. diameter and ⅛ in. thick.

PIPE.

Wooden pipes were used entirely until 1804, when 3,978 ft. of iron pipe were laid, but no more until 1818, when 400 ft. more were laid, and in 1820 their use was determined on, though wooden pipe continued to be also used until 1832, at which time 241,604 ft. had been laid. They were gradually replaced by iron pipe, the last being removed in 1860. The first iron pipes were imported from England. Of those laid in 1819, the 23-in. were imported and the 20-in. were cast by Samuel Richards, of Philadelphia, according to plans prepared by Frederick Graff.

There were 730.2 miles of pipe laid on Jan. 1, 1880. The original distribution system included an excessive amount of small pipe which has caused a great deal of trouble. As late as 1863 3-in. pipes were laid, but none since that time, except for connections. In 1864, 34 per cent. of the pipes laid during the year were of 4 in. diameter.

Since 1876 no pipes of less than 6 in. diameter have been laid for supplying streets.

Complaints of bad water were greatly reduced in 1861 by connecting dead ends in one ward and thus creating circulation, and additional connections made from time to time since have resulted in very great improvement in the character of the water delivered.

Prior to the consolidation of the city in 1854, the several districts had each an independent system of distribution pipes. The boundaries of districts were geographical and irrespective of topography, and much difficulty was encountered in the attempt to equalize the head. After consolidation fragmentary efforts to relieve this difficulty by connections of parts of separate systems produced the greatest confusion. In 1876 a comprehensive scheme was begun of systematizing the distribution and dividing the city into topographical districts or planes, each supplied from reservoirs of different elevations, so that the extreme range of head in each should not exceed 30 feet. This scheme is now pretty well consummated and with good effect. There are three main districts and two auxiliary pumping stations for very high isolated districts.

Of late years the introduction of steam fire engines requiring a much greater quantity of water than the old engines has obliged an entire reconstruction of the fire hydrant system. More

than 3,000 of the old type had been set before steam engines were used.

The use of meters has not been introduced.

The population, pipeage and consumption at each 10th year have been as follows:

YEAR.	Population.	Miles of pipe.	Daily consumption in millions of gallons.	
1800....	81,009	1	.....	
1810....	111,210	28	.....	
1820....	135,637	42	1.40	City proper.
1830....	188,797	87	2.46	
1840....	258,037	110	4.93	
1850....	408,702	128	5.84	
1860....	562,529	348	20.38	Consolidated city.
1870....	674,022	488	30.72	
1880....	846,084	746	60.	

The "department for supplying the city with water" has at its head an officer, styled the chief engineer, who was elected annually by the city councils prior to 1877. The term of office is now 3 years. The appropriations for the year are made by the councils on the basis of estimates submitted by the chief engineer. The chief engineers of the works, were, before consolidation, B. H. Latrobe, in 1801 and 1802; John Davis, in 1803 and 1804; Frederick Graff, senior, from 1805 to 1846, and his son, Frederick Graff, C. E., 1847 to 1855.

Since the consolidation, 1855, the chief engineers have been: Frederick Graff, C. E., 1855–6, and 1867–73; Samuel Ogden, 1856–8; H. P. M. Birkinbine, C. E., 1858–62, and 1864–7; Isaac S. Cassin, M. E., 1862–4, and Dr. W. H. McFadden, 1873–81.

The cost of the Fairmount works and their maintenance up to 1855 was $3,356,627.47, and the receipts $3,434,382.00. Since consolidation the cost of all works and maintenance to Jan. 1, 1881, was $15,828,331.80 and the receipts were $21,757,572.09.

For the year 1880 the pumping cost 5.51 cents per million gallons raised one foot.

III.—BROOKLYN.

The City of Brooklyn, on Long Island, separated from New York by the estuary called the East River, comprises within its corporate limits 20.50 square miles. It has a water front of 8¾ miles, and is about 7¾ by 5 miles in its greatest length and width.

Topographically, there is a central plateau beginning at the East River with an elevation of 90 ft. and running south easterly a general elevation of 80 ft., then falling to about 60 ft. and rising again at the easterly city line to about 120 ft. above tide level.

From this plateau, which is about a mile wide, the ground falls quite rapidly to near tide level on each side, except at the southerly corner of the city, where it rises to Prospect Park, 200 ft. above tide.

In 1855 its population was 205,250, supplied entirely from wells. In July, 1856, the construction of the water-works was begun, and water was introduced in April, 1859.

The source of supply is the southern slope of Long Island, at from 10 to 22 miles from the East River, a drainage area of 60.25 square miles, sloping gently up from tide-water to the foot of the central ridge of the island, which is four miles from tide-water at the western end and 11 miles at the eastern end of the gathering ground.

This plain is composed of fine sand, which is found to be saturated with excellent water, the surface of which rises 12 ft. per mile from tide level at the shore, and which appears at the surface of the ground in springs and streams where depressions occur in the ground level. The minimum observed flow from this area, occurred in 1880, and was equal to 9.4 inches on the watershed. This was all used for the city, none running to waste at the Ponds.

The water, collected in ponds formed by damming the streams, is conveyed by a masonry conduit built under ground with a gradient of 0.50 ft. per mile, to a pump well 7 miles from the East River. For 4.75 miles, from the pump well to the first pond used, the conduit has a concrete base 15 ft. wide, on which rest walls of rubble-stone masonry, surmounted with a semi-circular brick arch. The bottom and sides are lined with 4 in. of brick work. The bottom is a segmental arch of 9.75 ft. chord and 0.67 ft. versed sine. The side walls at 2 ft. above spring of invert are 10 ft. apart, and the arch is of 10 ft. diameter and 1 ft. thick.

Beyond the first pond the sectional area of the conduit is diminished proportionally to the amount of water to be conveyed.

At the pump well the inside bottom is 1.75 ft. above tide level.

The pump well is a rectangular chamber with granite walls and bottom. Its interior dimensions are 10 by 60 ft. and 35 ft. high. The foundations of the dams at the ponds and the conduit were built below the water table of the country from 2 to 4 ft., requiring constant pumping during construction. Near the pump well, it was from 7 to 9 ft. below water level, and the concrete was laid on plank platforms. The pump well foundation is 15 ft. below the ground water level, and two rotary steam pumps were kept going night and day for some weeks during its construction and exhausted the ground water in the vicinity, drying the wells for a quarter of a mile around.

The pump well supporting the engines rests on a platform of three courses of two-inch plank, spiked to sills laid in the sand. No settlement has appeared.

The first pumping-engine was constructed with a vertical steam cylinder of 90 in. diameter and 120 in. stroke, with an overhead beam. Two lifting-pumps, each 36 in. in diameter and 120-in. stroke, are operated by the beam, one at each end.

The inboard pump is under the steam cylinder.

The pumps are connected by a 36-in. pipe. An outer cylinder surrounds each pump-barrel, through which the inboard pump lifts and the outboard pump draws its water.

A second engine of the same type was erected in 1861. Both are of 15 million gallons capacity. The working of the first engine was not altogether satisfactory, and a fly-wheel has been added. A third engine of 14 million gallons capacity was erected in 1870. It is a double-acting condensing beam engine of 85-in. cylinder and 120-in. stroke. A double-acting bucket and plunger "Thames Ditton" pump 51 in. diameter is beneath the cylinder. At the other end of the beam is a fly-wheel.

For the high-service supply an engine was erected at Prospect Hill, taking its water from the mains at an elevation of 100 ft. and pumping it into the Mt. Prospect reservoir.

The natural daily yield of the streams in summer proving insufficient for the supply after several years, pumping engines were erected in 1874 at Watts' pond and Smith's pond, which are on the line of the conduit, but below its level, by which the water of those ponds is lifted into the conduit in the dry season.

Near the pump well, where the grade line of the conduit is from 7 to 9 ft. below the ground water, 30 openings, 4 by 2 in., were left at the spring line of the arch.

In 1859, with a depth of 3.67 ft. in the conduit, 150 million gallons daily were discharged into the conduit through these holes. Most of them were closed soon after as sand entered.

A storage reservoir was built at Hempstead Pond in 1873–6, of 250 acres area and containing 1,000 million gallons.

The distributing reservoir at Ridgewood is 3,400 ft. from the pump well and 163 ft. above it. Its water surface is 25.50 acres, its depth 20 ft. and its capacity 160 million gallons. It is constructed in excavation and embankment and the inner slope lined with a stone wall 12 to 15 in. thick. This wall was first laid dry, but on the admission of water the waves in high winds washed out the earth and gravel bedding and caused breaches in the wall, which was then repaired by filling the joints with cement mortar packed in with iron tools. The remedy was effective and the wall stands well yet.

The high-service reservoir on Mt. Prospect has 3.43 acres water area, and 20 million gallons capacity.

There are 546.29 miles of streets in the city, of which 328.31 miles are paved. The original distribution laid in 1858 comprised 120 miles of pipe, of which 2.5 miles were of wrought iron and cement and the remainder of cast iron, as are all pipes laid since that time. The main pipe from Ridgewood reservoir to the city was of 36 in. diameter.

No pipes were laid of less than 6 in. diameter at that time, and only 0.55 miles since of 4-in. pipe. A second main from the reservoir of 48 in. diameter was laid in 1867.

In 1870 a line of 36-in. main, 800 ft. long, was raised 7 ft. in the middle, without emptying it, the pressure in it being 40 lbs. per square inch at the time. There are now 350 miles of pipe laid.

The use of meters was begun in 1860, but up to Jan. 1, 1880, only 859 were in use, of the following types: Worthington, 405; Gem, 427; Brooklyn, 14; Union, 1; Nassau, 9; Eagle, 3.

There are 60,000 taps.

The population, pipeage, and consumption each ten years, are:

Year.	Population.	Miles of pipe.	Daily consumption in millions of gallons.
1860.....	266,661	156	3.44
1870.....	396,099	260	19.
1880.....	566,689	351	30.75

The careful investigation of many questions relating to water-works construction and management made by Mr. Kirkwood during the progress of these works, resulted in improvements of methods which have influenced most works of the kind since constructed.

The protection of cast-iron pipes from corrosion by the use of Dr. Angus Smith's process was first adopted in this country on these works on Mr. Kirkwood's recommendations.

Some of the 36-in. pipe used were manufactured in Scotland, and it was not until their importation that American manufacturers became convinced of the possibility and necessity of executing work of as good quality at reasonable prices.

To determine the proper elevation of the Prospect Hill engine-house, the first carefully conducted experiments were made on the flow of water in large pipes to find the loss of head. These experiments were made on the New York mains by Gen. Greene, and on the Jersey City mains by Mr. George H. Bailey.

(TO BE CONTINUED.)

We are pleased to acknowledge the receipt of the history of the water-works companies of Williamsport, Pa., from J. H. McMinn, Superintendent of the Citizens Water and Gas Company, of that city; report of the directors of the Lambertville-water Company, of Lambertville, N. J., from Martin Coryell, Superintendent; also an account of the proceedings upon the transfer of the Salem Water-works to the city authorities, Nov. 16, 1869, and the addresses of W. P. Phillips, Chairman of the water commissioners, and William Cogswell, Mayor of the city, from Charles H. Swan, M. A. S. C.E., Salem, Mass.

CORRESPONDENCE.

PROBLEM IN RAILROAD CURVES.

We have received answers to this problem from W. B. W. H., Jr., Jacksonville, Fla.; from W. B., Cincinnati, O.; from L. L. Nichols, Fort Edmund; from J. P. A.

RAILROAD GRADES.

NASHVILLE & FLORENCE RAILROAD,
MT. PLEASANT, Tenn., March 12, 1881.

EDITOR ENGINEERING NEWS:

I should like to hear from readers of ENGINEERING NEWS on the following question:

Is it better, in fixing grades for a railroad, to have a continuous grade in preference to the maximum grade and level, or in place of the level grade some lighter grade than the continuous? providing the latter grades are cheaper with respect to grading. For example, in an ascending grade, the level and maximum grades in filling and the reverse order for cutting are the cheapest that can be used. Respectfully,

C. W. BROWN, Chief Engineer.

WIND PRESSURE.

In our issue of Dec. 18, 1880, we published the following problem, and as no solution has been received, and as the question of wind pressure under any conditions is an important one, we republish:

STAYNER, ONT., Dec. 7, 1880.

EDITOR ENGINEERING NEWS:

A hose tower has been built here 60 ft. high, with bell-cote 9 ft. high. The base of tower is 14 ft. square, tapering to 8 ft. at the top. It is anchored to a stone foundation 2 ft. wide and 3 ft. deep, with abutments at corners 4 ft. square, by four iron straps 3 ft. up the posts running to bottom of foundation; straps $1\frac{1}{2}$ in. by 3 in.

What velocity of wind would be required to overturn above?

And what is the maximum velocity of the wind attained in this latitude? H. W. S.

HOWE TRUSS SPLICE.

PORTLAND, Me., March 15, 1881.

EDITOR ENGINEERING NEWS:

In your paper of Jan. 1 last, Mr. F. C. Doran gives a plan for a splice for a wooden bridge, which he says "has borne the tests of experiment and practical work, and will stand the analysis of science."

Not being a scientific man myself, I cannot judge how well the splice he proposes will stand the analysis of science; but as a builder of wooden bridges for the past thirty years, I am inclined to believe that the splice will not stand the tension in the lower chord of a wooden bridge. The sum of the four projections on his white oak clamp is only 10 inches. It is a very common thing in this part of the country to find the hooks of oak clamps a foot long sheared off, and it seems to me that one hook a foot long ought to hold as much as four hooks, each $2\frac{1}{2}$ inches.

The packing blocks, too, are so short that I should expect them to twist out of position very easily.

Will Mr. Doran tell us how, when and where the splice he refers to "has borne the tests of practical work?" E. S. SHAW.

RENUMBERING CITY STREETS.

OFFICE OF CITY ENGINEER, No. 17 CITY HALL,
NEW HAVEN, Conn., March, 1881.

EDITOR ENGINEERING NEWS:

In answer to your request that city engineers explain the method of re-numbering streets in their cities, I submit the following: The ordinances of the city of New Haven, Conn., provide that the Board of Aldermen shall have the power to cause numbers of regular series to be affixed to or inscribed on all buildings or parts of buildings, etc., fronting on any street in the city, at their discretion.

Under the power so given, the Board of Aldermen order the numbering or renumbering of streets whenever there is a necessity for so doing. In the early part of the year it is the custom of the City Engineer to send a communication to the Board calling attention to such streets as, in his opinion, need numbering or re-numbering. The matter is considered by a committee of the Board, who report orders for all streets that are to be numbered. The work of numbering or renumbering is done by the City Engineer Department and all work in that line is done previous to May 1, as the canvass for the city directory is made immediately after that date. When an order is received for the numbering or renumbering of a street, a tracing from our city map, drawn to a scale of 100 feet to one inch, is made of that street, showing all lot fronts and the houses. Commencing at the proper end of the street, the frontages of each block or square are marked off in spaces, not more than 20 feet of frontage being allowed for one space or number, one number being allowed for each space. All streets are numbered from the easterly and southerly ends, the odd numbers on the northerly and easterly sides and the even numbers opposite the odd numbers next preceding them. From the map or tracing thus prepared, the buildings or parts of buildings are numbered, the entrance to each building or part of building being given the number of the space that it is opposite to. Twenty feet of frontage is the usual amount allowed for each number, but on streets occupied for business purposes this is reduced to 12 or 15 feet. In numbering or renumbering a street, the City Engineer causes a notice to be left at each place to be numbered, informing the occupants of the action of the Board of Aldermen, and what the new number is. The ordinances require the owner or occupant to affix the new number within sixty days, under a penalty of not less than one or more than twenty dollars for each offence, and a like penalty for each day thereafter until the order is complied with. The owner or occupant of the building furnishes the number, but the orders of the Board of Aldermen are that it shall be a substantial one, and placed on or over the door or entrance, where it can be seen at all times. It is quite customary to have the number painted on the transom over the door, where it can be seen at night as well as by day. The necessity for renumbering our streets is generally caused by one of the following reasons: The change of buildings from residences to business houses, and the more thickly settlement of the streets, the extension easterly and southerly of streets, and the original numbering having been made from the wrong end of the street. The tracing of each street forms our record of the numbering, and shows at a glance at any time the proper number for any building.

Respectfully yours, CHARLES E. FOWLER,
City Engineer.

CORTHELL'S HISTORY OF THE MISSISSIPPI JETTIES.

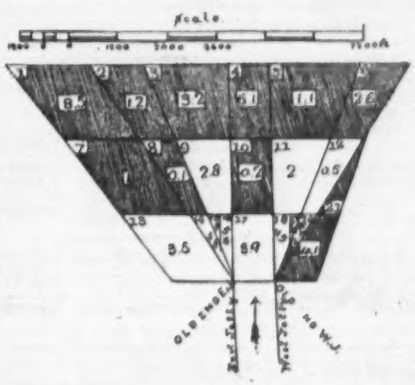
PORT EADS, LA., March 5, 1881.

EDITOR ENGINEERING NEWS:

I wish to make known through your columns an error which occurs in Appendix XXII, Table No. 1, page 372, of the "History of the Jetties at the Mouth of the Mississippi River", by E. L. Corthell, Chief Assistant and Resident Engineer, during their construction. In this table the area of sub-division 16 should be 395,320 instead of 305,320, and the cubic yards of water for 1879 should be 571,281 instead of 271,281. These amounts as corrected are the same as given in table No. 2, of the same appendix for the same sub-division, as they should be. With these corrections made the average increase in depth over the area considered (viz., sub-divisions 7 to 19 inclusive) would be 1.7 feet instead of 1.22 feet.

Since the author has exercised such care in selecting such sub-divisions as would show the greatest scour in front of the jetties it may be interesting to him to know that what he believes to be the true result is too small by nearly one-half a foot.

In this connection I would add that it would have been but justice to those who made the original deductions, in the appendix above referred to, had the author made reference to the official report from which he extracted them, and further if he had given the results which follow when the whole number (21) of sub-divisions are considered. He says that "a more extended area has been surveyed at various times" etc., and refers to Plate 24, of his History; and yet his deductions are made from only a portion of this area which is less than one-half of the total area represented on the Plate to which he refers. The question which naturally arises is; what is the result when all these sub-divisions are considered? But is there anything in the History which gives this result? Is there any reference to the official report in which this



result may be found? If so, I have failed to discover either.

On page 36 of the Twelfth Annual Report of the U. S. Inspecting Officer, will be found the table in full (from which the appendix above referred to is extracted) giving the results of these 21 sub-divisions, from which will be seen that the mean *fill* or *shoaling* over the whole area is 1.16 feet.

The acompanying diagram represents this "more extended area" which the author speaks of. The number in the upper left hand corner of each sub-division, is the number of that division, and the other figures are the difference between the mean depth in 1876 and that in 1879, expressed in feet and tenths of a foot, and therefore express the change in each sub-division during this period. The shaded divisions (no's. 1 to 8 inclusive, 10, 20 and 21) represent the area which *shoaled* and the remaining division the area which *deepened*.

Let us take this diagram and follow the author's text. Near the bottom of page 220 he says; "by combining those that lie more directly in front of the jetties (viz.; seven to nineteen inclusive)," etc. Now we find, according to the author's reasoning, that divisions 13 and 14 "lie more directly in front of the jetties" than 20 and 21 do, else why does he omit 20 and 21, and how surprising that these two divisions show a *shoaling* of 2.2 and 4.1 feet respectively. These deductions, together with the fact that no reference is made to divisions 1 to 6 inclusive, which show a considerable shoaling, make the conclusion evident that Mr. Corthell (the author) was looking for a deepening, and conveniently overlooked the shoaler areas in his search.

Further comment at this time is unnecesary, but, in conclusion, I must say that the author does in-

justice to those the results of whose labors he uses, in torturing valuable results by meagre extractions, and that, too, in a manner which reflects but little credit upon himself as one wishing to treat this important subject with fairness.

C. Donovan.

PROBLEM IN RAILROAD CURVES.

Newburgh, N. Y., March 15, 1881

Editor Engineering News:

I beg leave to offer the following solution of L. E. Vel's problem in your issue of March 5, which may be stated thus:

Given: The angle $\Delta = 60^\circ$ $\Delta_1 = 40^\circ$ and $\Delta_2 = 20^\circ$ and the radii R_1, for 2° curve, R_2 for 1° curve; to find the sides $S_1 = AC$ and $S_2 = BC$.

1st. Find the half difference of the two sides by

$$\tfrac{1}{2}(S_2 - S_1) = \frac{R_2 - R_1}{\cot.\ \tfrac{1}{2}\Delta_2 + \cot.\ \tfrac{1}{2}\Delta_1}$$

2d. Find the half difference ($\frac{1}{2}\gamma$) of the angles CAB and CBA by

$$\cot.\ \tfrac{1}{2}\gamma = \frac{R_1}{\tfrac{1}{2}(S_2 - S_1)} + \cot.\ \tfrac{1}{2}\Delta_1$$

3d. Find the half sums of the sides by

$$\tfrac{1}{2}(S_2 + S_1) = \frac{\tfrac{1}{2}(S_2 - S_1)\cot.\ \tfrac{1}{2}\gamma}{\cot.\ \tfrac{1}{2}\Delta}$$

4th. Find S_1 and S_2 by subtracting and adding their half sum and half difference.

The solution is as follows:

R_2 1° curve	5729.65	
R_1 2° curve	2864.93	
	2864.72	Log. 3.457082
Cot. $\frac{1}{2}\Delta_1$ (20°)	2.74748	
Cot. $\frac{1}{2}\Delta_2$ (10°)	5.67128	
	8.41876	" 0.925248
$\therefore \frac{1}{2}(S_2 - S_1)$	340.278	2.531834
R_1 2° curve		" 3.457115
	8.41940	0.925281
Cot. $\frac{1}{2}\Delta_1$	2.74748	
$\therefore \frac{1}{2}\gamma = 0^\circ\ 07'\ 02''$	11.16688	" 1.047932
$\frac{1}{2}(S_2 - S_1)$	340.278	2.531834
Tan. $\frac{1}{2}\Delta$ (30°)		9.76143
$\therefore \frac{1}{2}(S_2 + S_1)$	2193.840	3.341205
$\therefore S_1 =$	1853.562	
Also $S_2 =$	2534.118	

Also $CAB = 30^\circ + 5^\circ\ 07'\ 02'' = 35^\circ\ 07'\ 02''$
Also $CBA = 30^\circ - 5^\circ\ 07'\ 02'' = 24^\circ\ 52'\ 58''$

and the side AB of the triangle ABC may be easily found.

The above formulas are taken from "Searles' Field Engineering," page 106 (after correcting eq. (107) in which R_2 and R_1 should change places). A similar problem is worked out on page 108 of that book. I would not venture therefore to offer this solution at second hand, did not this example offer an excellent refutation of the astonishing statements made by Prof. Philbrick in the same issue of your paper. His assertions would be sufficiently remarkable if made by some one to whom, by reason of a faulty or neglected education logarithms would appear to be "a delusion and a snare," but when made by a professor, and not only so, but by a professor of civil engineering in a State university, the assertions are simply astounding.

His words imply that logarithms have come down to us "from the misty past," whereas they are a recent invention compared with the antiquity of such mathematical processes as he admires. The very first tables of common logarithms were computed by Prof. Henry Briggs, and first published in 1618, just 263 years ago and 126 years after the discovery of America. The mathematicians of that day undertook gladly the immense labor of elaborating the logarithmic tables, actuated by a desire to avoid the troublesome and tedious arithmetical methods till then in vogue. They hailed the new invention with the greatest enthusiasm, and congratulated one another on their happy escape from so laborious a thraldom. Few inventions have blessed mankind with a greater saving of both time and labor than the invention of logarithms.

Now, if this be true, and true it most certainly is, how does it happen that logarithms may not be advantageously used, if we are to believe Prof. P. in connection with field practice? Is time in the field of so little value, or the wages of six or eight men standing idly by, of so little importance that the engineer may freely squander them while he seats himself in the kindly shade of a neighboring tree and goes into no end of multiplications and long divisions with their many chances of error, rather than sacrifice a principle by turning to the logarithm with which grasping publishers have sought at great expense to swell the volume and cost (and, therefore, the *un*popularity) of their books?

But the Professor plainly takes the ground that logarithms are *worthless*. How does he defend it? By reference to a class of students, who, using *identical* tables, scarcely ever agree in their results; hence, he concludes, the *tables* must be wrong. Query: Does he refer to one of his *own* classes?

His statement that logarithmic tables are less accurate than tables of natural numbers is a companion piece to his other statements that approximate formulæ yield more accurate results than accurate formulæ (if the latter are at all tainted with logarithms), and that computations are more easily and quickly made without logarithms than with them. These bold assertions, made without proof or illustration, call for no argument in reply, but are here simply and explicitly denied.

I, on my part, make the plain assertion, "with no fear of successful contradiction," that the use of logarithms in field computation is time-saving, conducive to accuracy, and that they serve to relieve the engineer from the confusion and snare of the multitude of figures incident to the "natural" method. As an illustration of this I refer to the above solution, which in fifteen lines and two columns gives all the figures required for finding one side, while in three lines more are given the other side and the two unknown angles in the unknown triangle ABC.

Now this problem is perfectly legitimate and one of common occurrence in railroad field-work. It must be solved before, with the given data, the curve can be located. The man who has propounded it in your paper calls very properly for "the shortest and simplest method" of solving it.

I therefore offer this logarithmic solution, and I challenge Professor Philbrick,

1. To show any inaccuracy in the method or in its result.

2. To offer any solution whatever by the "natural method," or by aid of any "useful" tables other than the logarithmic, which will be equally accurate with the above, if equally brief; or for which you, Mr. Editor, would be willing to afford the space necessary to publish in full all the figures required.

Wm. H. Searles.

ENGINEERS' SOCIETIES.

BOSTON SOCIETY OF CIVIL ENGINEERS.

A regular meeting of the Society was held on the evening of Jan. 19, President Thomas Doane in the chair. The committee to whom was referred the communication of William E. Pettee, C. E., of Lakeville, Ct., in relation to the importance and propriety of the Society issuing a work on the "Law and Practice for Land Surveyors in the New England States," reported that, while they appreciated the need of such a manual or guide, its preparation did not come within the province of the Society. The committee considered the practice in New England as very simple and generally understood, and believed such a work should emanate from the department of "Law and Conveyancing." Should the enterprise be privately attempted, the hearty co-operation of the Society could be relied upon.

The articles of association of "The Association of Engineering Societies" which were adopted at the meeting of delegates at Chicago, Dec. 4, 1880, were ratified by the Society and Mr. S. E. Tinkham was elected as the representative of the Society. It was also voted "That it is the sense of this Society that the plan of an independent publication of the joint proceedings, as proposed by Mr. Wellington, be adopted."

Mr. John R. Freeman was elected a member, and Mr. Edward S. Shaw was proposed. The Secretary read a paper by the late E. N. Winslow, on the "Fall River Bridge," which we will publish in a future issure.

LIVERPOOL ENGINEERING SOCIETY.

The usual fortnightly meeting was held at the Royal Institution Wednesday evening, March 2, the President, Mr. Alfred Holt, being in the chair.

A paper on "The Application of the Electric Light at the Free Public Library, Liverpool," by Mr. John S. Brodie, was read in the author's absence by the Hon. Secretary, Mr. Allies. The author premised his remarks by stating that though many and varied applications of the light for outdoor purposes had been made, it was reserved for London and Liverpool to promote its introduction for the purpose of illuminating large rooms—the former at the reading-room of the British Museum, the latter in the new large reading-room called after Mr. Councillor Picton. The considerations which led to the adoption of the light were first the serious loss and damage sustained to the costly and handsome bindings of the large collection of valuable works caused by the injurious fumes given off by gas, and secondly the extreme difficulty found in ventilating the old reading-room when crowded of a winter's evening, owing to the effluvium arising from the number of people and from the large quantity of gas required to effectively illuminate the room. The last and chief consideration, pointing as it does to the injurious effect of gas on the human constitution, cannot be too highly estimated. It may be stated that after the electric light had been temporarily in use for some time, when gas was used instead for a few weeks during the substitution of permanent machinery for working the light, the library officials were overwhelmed with complaints on account of not only bad light, but bad ventilation. The details of the engine power required to generate the electric current and of the light itself, which is of the description known as the Serrins patent lamp or regulator, were then stated very completely, and one of the lamps was exhibited and explained by Mr. Clare, the curator in charge of the machinery at the library. In conclusion the author stated that although the question of economy was not considered in the matter, yet on comparing the cost of the electric light with that of gas used from the same room, the former came out more favorable in spite of being saddled with the first cost and working expenses of machinery for 10 lamps, three being all that at present had been used.

Mr. R. R. Bevis, Jr., then gave an interesting description of the "Brockie" lamp now in use at Messrs. Laird Bros.' workshops at Birkenhead. Discussion on this interesting subject was deferred to the next meeting.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.

This Society held a meeting at Pittsburgh on the 15th inst. to discuss the proposed railroad into the mineral regions of Virginia. Mr. Reuben Miller read a paper, giving the results of his observations in the region.

Mr. James H. Hopkins said that if Pittsburgh is to maintain its supremacy as a manufacturing city it must have cheaper ores He spoke at some length in reference to the relative value of narrow-gauge and standard-gauge railroads. He insisted that in a mountainous region, especially, a narrow-gauge road has an immense advantage over a standard-gauge road in the cost of construction and the cost of operating.

Mr. J. D. Weeks showed upon a map the proposed route of Senator Davis' road in West Virginia to connect with the Richmond & Allegheny road. The latter runs from Richmond to Clifton Forge. The Richmond & Allegheny road must be completed, by the terms of its charter, by Feb-

ruary next. Senator Davis' road could easily connect with the Richmond & Allegheny, and the two roads already started, the Pittsburgh, Virginia & Charleston and the Pittsburgh Southern, should be pushed through as speedily as possible. The wonderful resources of West Virginia and the valley of the James are only awaiting outlets for their development. The markets thus opened to Pittsburgh products will be of immense value to it. In the West they are building railroads from no place to the end of a squirrel track, where there is nothing to be found except the squirrel barking up a tree; and yet, while hundreds of miles are being built in such countries, so rich a country as this is being neglected.

REPORT OF COMMISSIONER OF PUBLIC WORKS OF THIS CITY.

On the 12th inst., Hubert O. Thompson, Commissioner of Public Works, transmitted to the Mayor a report of the transactions of his department for the three months ending Dec. 31, 1880, together with a review of the work during the entire year. Until Dec. 11, the department was under the direction of Allen Campbell, and the report refers almost exclusively to his administration.

During sixty-eight days of the quarter, the natural flow of water in the Croton River was not sufficient to supply the aqueduct, and 2,636,000,000 gallons had to be drawn from the storage reservoirs and lakes. In repairing and strengthening the aqueduct, 1,909 lineal feet of additional arch were built, 1,034 cubic yards of protection and retaining walls were constructed, and 1,512 cubic yards of earth removed from the top to the sides. Nine and four-tenths miles of pipes were laid to extend the distribution of Croton water, and 159 new hydrants were set. Since the advent of cold weather the quantity of water pumped for high-service use had to be increased from 9,000,000 gallons per day to 10,500,000, the new works at Ninth avenue and Ninety-eighth street supplying 8,000,000 of this amount.

The excessive waste of water during cold weather made the necessity of extending the use of water meters more urgent, and 688 meters were placed during the quarter, making the total in use at the close of the year 4,002. Over 18,340 house inspections were made, and 4,101 cases of leaks and wastage were discovered. Work on the new reservoir at Kensico was begun in October, but because of severe weather slow progress was made.

The area of street pavements and repavements laid during the year was 67,488 square yards; 7,917 feet of new sewers, 255 feet of culverts, and 9 receiving basins were built, making the total sewerage south of Harlem River 376 7-10 miles, with 4,573 receiving basins. Eleven new contracts were made for regulating and grading streets, and four were finished.

The number of public lamps in the city was increased during the quarter from 23,475 to 23,511. The collections of revenue from the Croton water service amounted to $232,861.52, of which $224,996.07 was for rents, $5,724.45 for penalties on rents, and $2,121 for permits to tap Croton pipes. The department also collected $32,103.08 from other sources.

In reviewing the work of the department for 1880 Mr. Thompson gives in his report the following expenditures:

On appropriation account	$1,884,381.68
On assessment fund	461,508.83
On funded debt account	515,070.10
Outstanding liabilities on appropriations of 1880	171,827.03
Total	$3,033,447.64

The rain-fall in the Croton basin in 1880 was only 38.52 inches, fully two inches less than in any year since the introduction of Croton water. From May 19 to December 31 there were only 19 days in which water ran over the dam, and 8,221,000,000 gallons were drawn from storage reservoirs and lakes to supply the deficiency in the natural flow of the Croton River, and keep the aqueduct running to its full capacity of 95,000,000 gallons per day. During 1880 the aqueduct improvements were extended 10,300 lineal feet, and appropriations for 1881 will allow about the same amount of work to be done. The Bronx River supply of water cannot be made available under two or three years, the work having been delayed by the severe winter. Last year 23¾ miles of pipes were laid, and 550 new fire hydrants placed. The total length of pipes in use at the close of the year equaled 503.06 miles, with 6,047 fire hydrants. During cold weather the average consumption of water was 8,000,000 gallons per day more than the carrying capacity of the aqueduct, reducing the supply in the city reservoirs at that rate, and causing a corresponding reduction of pressure in the pipes. After considering at length the constant increase in the supply of water needed in the city, Mr. Thompson earnestly advises the building of a new aqueduct of sufficient capacity to anticipate the needs of the city for a long period, and urges the importance of immediate consideration of the subject and prompt action. During the year 244,807 square yards of new street pavements were laid, there being at the close of the year 333½ miles of paved street south of the Harlem River. The experiment of lighting Broadway with electric lights from Fourteenth to Twenty-third streets is reported as satisfactory, and further tests will be made. The report closes with the following statement of the revenue of the department for the year 1880:

Receipts for Croton water rents, penalties, and tapping pipes	$1,560,598.57
For sewer permits	24,522.03
For vault permits	30,549.00
For sales of old materials	3,904.13
For furnishing and setting meters	13,467.50
For restoring pavements over excavations	7,527.00
For rent of derrick	1,583.29
For miscellaneous items	379.55
Total	$1,651,531.07

SCIENTIFIC BOOKS.*

Mr. President and Gentlemen of the American Institute:

It is with much diffidence that I appear before you this evening upon your invitation to read a paper on "Scientific Books." Being rather a novice in the rôle of public reader, I fear I can do but scant justice to so great a theme, and can only express a hope that I may interest you in a few phases of the subject. In stating the matter, therefore, of our consideration as "Scientific Books," quite a wide range of ideas present themselves. It is the "thing," in vulgar parlance, in this our day, to give to science an every-day dress; and it is also the right thing for all manner of men to have some knowledge of scientific subjects, and to be able to converse somewhat knowingly on scientific topics. So also it is very common for us to describe many of the most ordinary vocations from a scientific standpoint, and in this way we hear of culinary, that is, kitchen science as well as scientific horse-shoeing.

We can partially divide up our scientific books into a few defined branches.

Chemical and Physical.

Medical.

Geological, including Mineralogy and Mining.

Astronomy and Meteorology, including Navigation and Seamanship.

The so-called Natural Sciences, Biology, Zoology, Botany, etc.

Mathematical, which to a certain extent is combined with many of the other branches.

Civil and Mechanical, which may embrace also Electric, Sanitary, and Hydraulic Engineering and Architecture.

All of these, however, so impinge as it were one against the other that it becomes difficult at times to draw lines of demarcation, and the labor of preparing a well-classified catalogue is no easy matter.

Finally, we have Social and Political Science, and Military and Naval Science, and last, but not least, Popular Science, which to a very great extent endeavors to grasp and draw into itself all the forms and phases of all the branches we have tried to enumerate.

It is my intention, though, this evening to confine myself to a few thoughts on what is commonly termed "Engineering Science," mechanical and civil. In all languages, particularly English, French and German, works bearing upon "Construction" take prominent places. Whether we regard them simply as books of learning, or as works for practical information; whether they apply to the construction of buildings, to the designing of steam engines, to laying out roads or railways, to the surveying of mountains or plains; whether we look to them as the exponents of the master minds who conceived our great canals or planned out the ocean steamer; whether we regard them as embodying the principles employed in our water supplies for great cities, or look to them for the theories enunciated, or for the actual plans of our various bridges, or even if we descend to the mere description of the giant tools employed in the workshop and forge—from whatever point we take them, these engineering books of to-day, as well also, to some extent, those of a past day, take the foremost rank among works of science.

One of the earliest leading publishers of scientific books, and one who in his day made this class of literature a representative one, was John Weale, of London. We all know, I presume, what the *Weale's Series* are—the little green or red-covered books, in limp or flexible cloth, with flush-cut edges. Mr. Weale has been dead many years, but his series of reasonable-priced scientific treatises upon all manner of subjects still lives. It is true the advancement science has made has rendered necessary many changes in these little books. Some have been re-written and enlarged and altered, as they have passed down through different publishers' hands; their number have been added to, until there are now about 200 of them, and they have had a sale of many thousands and continue to sell. To a considerable extent, engineering science is predominant in this series, but they cover a wide range of other subjects. No attempt has been made to emulate this series of Weale, unless we might mention in connection with it the "Roret Manuels" and the more recent "Actualities Scientifiques," and the "*Science Series*" of Van Nostrand, New York, begun a few years ago.

The first named of these is, or rather was, a popular series in the French language, of compact little volumes upon technology or the science of the workshop, and were largely embraced within the domain of applied chemistry. The "Actualities Scientifiques" of Mallet-Bachelier, of Paris, are no more popular than the Weale series, but cover a rather wider range of subjects, and are strictly less scientific, while for Van Nostrand's we can only say that, so far as the higher branches of science are concerned, they would take precedence of all, but as individual treatises are much less exhaustive of the subject, and in many instances partake more of the character of a monograph, on some special branch. Some of Mr. Weale's other publications, such as his collections of plans and drawings of bridges with descriptive test, his large and exhaustive works upon the "Steam Engine" and on "Railways," his fine volumes on "Architecture," his "Quarterly Papers on Engineering," and another series in same style on "Architecture," while expensive as books are remarkable examples of scientific literature, and remain as monuments to the man John Weale more enduring than brass or stone.

In speaking of Mr. Weale's endeavor in his series to cheapen this class of literature, we are reminded of an apparently wide-spread error as to the so-termed expensive character of most scientific books. It is true, many, and if not all, are dear, if we make comparisons between them and works of general literature or of fiction. But does one person out of one hundred know the reason why, in the one case, the price is seemingly high, and in the other reasonable? It is a question that is often presented to me. Let me assure you that, with the greater number of all books of science, the sale is relatively small, even under the most favored circumstances. Perhaps 1,000 copies would represent the maximum number sold, on an average, of ordinary scientific books. Of course, such as are used as text-books in technical schools, and a few others, may have a larger sale, but as a rule, technical books that reach a much greater demand than this, are apt to be left behind by the science on which they treat, and to keep up to it the stereotype plates are of but little value, and new ones must be made—that is, a *new book* really, so far as outlay to publisher is concerned. Now, with works of history or fiction, the numbers sold are not hundreds, but hundreds of hundreds, 5,000 is considered a minimum number for many of them, and prices, therefore, are graded on this basis. These the large sales permit to be made low, and lowness naturally increases buyers. Then, these classes of books, history, fiction, poetry, biography, etc., require little or no change. Edition after edition is run off from the plates with no further expense than the cost of paper, printing and binding, and a set of plates of a standard work in general literature is quite often as good property 25 years after first issue as at five. It is true publishers often make mistakes in the books they bring out. To some extent, also, it is a kind of lottery. They take the chances how this or that book may meet the public wants and tastes, and, consequently, poor books, scientific particularly, or such as the public do not for some reason take to, have poor sales, and find their way at last into the old paper shops. A poor novel can oftentimes, though, be made to sell by gushing advertising; but I never knew a scientific book to be. These various reasons, if you consider them for a moment, will convince you that scientific books cannot be afforded as low as other kind of literature. The same-sized book of a standard technical scientific grade, one printed in same-sized type, on same quality of paper, and of relatively the same number of pages, as one either of fiction, travel,

* Lecture delivered before the Polytechnic Club of the American Institute, Feb. 24, 1881, by Wm. H. Farrington.

history, poetry or theology, will be usually about double the selling price of these latter-named books. In these statements I bear mainly on American publications, as a somewhat different condition rules with English. The publisher in Great Britain seldom stereotypes the better class of books. I trust all understand me when I use the word "plates," for I mean, of course, the stereotype or electrotype plates of the pages from which books are now usually printed, and not the mere pictures or illustrations. Most of the English houses, however, print from type, not from plates. After an edition is printed the type is distributed, and no more copies can be made without the same expense of resetting type. Hence the publisher, as a rule, makes larger editions, and has to get all his profit from them. If plates are made, the editions can be smaller, as the book can be duplicated at cost of paper, printing and binding. There are some exceptions in England as to the plan of not making plates of scientific books, and controversy exists among the leading houses there as to the best policy. The numerous lending libraries exert considerable influence upon the publishers of general literature, and as for the scientific works, one of the largest houses in London uses as an argument against casting plates from the type, that every scientific book, to keep up with the times, must be rewritten or altered materially every few years. It is better, they claim, to print an edition from the type, to run an estimated length of time, and to fix price upon the cost of the whole, which must necessarily be high, and then, when sold and the market seems to demand another edition, to print an entirely new and revised one.

We do know science goes along with great strides, faster than books can keep up to, and the English publishers' views are right often times; but, publishers here, nevertheless, believe it better to cast plates of their books, and print smaller editions. If the book sells faster than anticipated, it can be reproduced with slight changes, and even with additions, and sometimes reductions in price can be afforded. A few English houses act on this principle, notably the publishers of Prof. Wm. J. Macquorn Rankine's different books. These are all stereotyped, and slight changes only, as a rule, are made or required in the plates as the different editions are successively produced.

In this connection I would state that the large sale these books have had in this country, as well as, of course, in England, bear evidence of their value. Considering the high character of their contents, I might say, their abstruseness, it speaks well for the ability of our students and of the education of our engineers that so large and continued demand exists here for them. Taking into account the closely printed pages of these several volumes, the amount of matter in them, the price at which they are sold is far from high. We must bear in mind, too, that a duty of 25 per cent. on their import value (whether for "revenue only," I do not pretend to say) is imposed upon all foreign books. This, of course, is added to the cost by the importer and is virtually paid by the consumer. In this connection, further, I would explain that the closely printed pages of many scientific books, containing, also, matter arranged in tabulated form, algebraic formulæ, etc., enters largely into the cost of production, in comparison with other classes of books. In most cases (we possibly may as well except those issued by H. C. Baird & Co., Philadelphia, and trust we will give no offence in so doing) books of technical science are all closely printed; that is, there is less leading, or spreading, with less margin to the page, and often smaller sized type is used. This comes from the fact that many books of this character for the use of engineers and mechanics are required to be compact, handy, not too bulky, and must contain all it is possible to get into a relatively small compass. Very often with this idea in view it is printed on thin paper, so that the number of pages will not swell the bulk. I would instance such as the well-known "Haswell's Pocket-Book," "Molesworth's Pocket-Book," the excellent "Hamilton's Useful Information for Railway Men," the "Civil Engineer's Pocket-Book" of Trautwine, and the more recent "Field Engineer" of Mr. Shunk, Chief Engineer of our elevated roads here. The tabulated matter referred to, in these classes of books, more especially those on theoretical science, also the large amount of formulæ, algebraical and geometrical, which so largely predominates, add greatly to the expense of production, and if we except the works of art, fine holiday books with illustrations, or elaborate books with fine engravings, *these* scientific works cost, in the element of composition, so termed, or the first setting up in the type, double or treble what ordinary books cost.

In all the arguments which I would seem to have used in either justification or explanation of the necessarily high price of most of our scientific books, I would not wish to be understood as depreciating the actual sales of many of them. Some have been sold in remarkable numbers, but there are exceptions, which, like "Haswell's Pocket Book" or "King's Notes on the Steam Engine," met a decided want and nothing better or equally as good, perhaps, has come to supplant them. They sell, and continue to sell, for the reason they are good and are wanted.

And here I would add that, in spite of the great number of books upon science in all its phases, still there are constant inquiries for some treatise or book that does not exist, something not obtainable in a separate or distinct volume by itself. Of course there is to be found in the scientific cyclopædias, Watts' "Dictionary of Chemistry" in 7 volumes; Wurtz's "Dictionnaire de Chemie," 5 volumes; Ure's "Dictionary of Arts, Manufactures and Mines," in 4 volumes; Tomlinson's "Cyclopædia," 3 volumes; Knight's "Mechanical Dictionary," an American work, in 3 volumes; also Appleton's "Dictionary of Mechanics," American, and now in course of publication; Spon's "Dictionary of Engineering," 3 volumes, and the new "Encyclopædia of Chemistry," in 2 volumes, based on Murpratt's well-known work; I say there is to be found in these various books, and you see how numerous and really extended they are, every conceivable subject treated upon, but necessarily many of the articles are condensed, do not cover everything that can be given upon one branch of manufacture, or of machinery, or of engineering, and persons do generally want to know all there is to be said, or to be ascertained upon anything they may at the time be interested in. It is hard sometimes to convince persons that a book devoted to some one particular subject named would hardly pay to produce as a business venture. It is as well to recognize this fact that persons who have the necessary knowledge, experience and ability to prepare such a book do not always want to give to the world their knowledge and their experience. Perhaps their time is too valuable to devote to the right preparation of the work, and they can make more by sticking to their business, than could be realized by the sales of the book. Then, there are some manufactures, like the chemical technological processes, in which secrets, known only to the manufacturer exist, and these he does not care to give to the business world. It is true many write for the glory, perhaps of seeing their name on the title page of a goodly volume, and this may be too often the excuse for many a book's appearance, but it is less often so, I believe, with scientific literature than with any other. I remember a case where a gentleman was quite taken aback because he could not find any work giving the details of processes whereby colored tiles were made. I told him no such book, as I was aware, existed upon the subject, and that, further, that I doubted if any tile manufacturer would be willing to give his knowledge away by writing a book about it. I imagined in this case, but how true it may be I cannot say, that there is a secret in the ingredients put in the clay of the tile before burning in order when burnt the colors may be as required. I knew again of a case where a volume existed upon "Tanning." The book gives, in the usual way with this class of works, of which there are very many, the processes and preliminaries required, but when actual recipes are found, the quantities in all cases are left blank. The only way really in which the book could be rendered valuable was in getting these quantities filled in and these the author was prepared to furnish for a consideration. These remarks, however, apply with altogether less force to our engineering works. There is but little of a secret character about the contents of any of them, and perhaps I am therefore departing rather widely from the road I laid out at the start, in these possibly desultory remarks. I do not wish to weary you with any elaborated descriptions of *many* of our important books in engineering or mechanical science; besides, I presume you are all more or less familiar with the most of the well-known ones; still, I am here to say something about them, and I have selected a few—just a few—as examples, as types, of what they are. Perhaps you do not know how many there are of these kinds. I confess *I* do not; but I can assure you they are too numerous to count up, just in this one branch of science. For all general purposes, we can divide them into two classes—the theoretical and the practical—and while we know this division cannot be a very close one, as some of them partake more or less of both these characters, yet for most purposes it is a distinction. The theoretical books are mainly used as text books in our science schools and for general students, while the practical ones are the tools of the workman. We can take, as a prominent example of the former class, the volume on mechanics by the German writer Weisbach, which is regarded as the standard upon the theory of mechanics. It has passed through many editions in the original, in fact, is all the time passing through. Being issued in parts, like many French and most German books, the parts keep coming along, one after the other, and before the concluding portion of the volume reaches you a new edition of the first, or some intermediate part, is issued by the publisher. It has grown, however, from two comparatively thin octavo volumes into three bulky ones. The first of the three is the representative one, however, of the writer; it covers the theory of machines and mechanism from every point, and is really a great work. An early translation of the whole work appeared in London some years ago, published by the Bailliere Brothers in their "Library of Standard Illustrated Scientific Works," which embraced many valuable treatises, was reprinted in this country, in Philadelphia, but both these editions have been long out of print. The fourth German edition of the first volume, "Theoretical Mechanics," translated by Mr. E. B. Coxe, of Luzerne County, Pa., was published in this city in 1869. It forms a large octavo volume of 1,100 pages. A *portion* of the second volume, "Applied Mechanics," translated by Prof. Du Bois, was also published in this city a few years since; but the third volume, treating of the construction of machines, is written so entirely from a European standpoint, and embracing therefore so much at variance with our better American practice, is hardly likely to be put into English for the reason that it certainly would not be popular. Prof. Rankine's works we have alluded to before. They are all of them of a rigid theoretical character. They embrace one on "Mechanics," one on the "Steam Engine," another upon "Machinery;" one on "Civil Engineering," and recently a volume of his miscellaneous papers, collected since his death, has appeared. Being of a high mathematical grade, they may be truthfully said to be abstruse in every sense of the term, yet they are each and all commended as the best text-books upon the subjects they treat.

They really need, however, explanatory notes or aids. Some such have been prepared, and one series of notes by Professor Allan, of Virginia, was printed. Otherwise much help is required by the student from the teacher, either in the shape of preliminary or accompanying lectures.

An American work, far less abtruse than those named, and which has earned a reputation on its merits, is Mr. Shreve's "Treatise on the Strength of Bridges and Roofs." It is similar in subject to the more widely-known English book, "Stoney on Strains," but, unlike that, it deals only with ordinary algebra in the problems, and is a much smaller work. The subject of Graphics, or teaching by diagrams, is now attracting attention here, though it has long been a method in repute with the German scientific men. One of the cleverest of the works on the subject, and I believe one of the simplest, is Van Ott's. It has been put into English, and forms but a small volume. As an elementary American work on this subject, Professor Eddy's is probably the best. It first appeared as a series of papers in the pages of "Van Nostrand's Engineering Magazine," where it attracted considerable attention. For a practical application of Graphics, I can refer you to Professor MacCord's book on the "Slide Valve," which is used as a text-book at the Stevens Institute, and is commended as an excellent example of the handling of the subject.

In "Hydraulic Engineering," one of the best known theoretical treatises is, or was, D'Aubisson's, a French work. Mr. Bennett, an engineer, of Stonington, Conn., translated it some years ago into English, but it is now out of print.

Coming down, or going up, to our practical books in engineering or mechanics, the first, we are apt to think of are those of John Bourne, for few have stood the test of time better. His books may all be classed under the head of "Steam Science," if I can use that term. Perhaps the best known of any is his "Catechism of the Steam Engine." The form of question and answer was adopted as a means of imparting more clearly and readily the information desired. It has been many years before the public, was reprinted in this country years ago, and still sells well. A "Hand Book of the Steam Engine," to some extent a key to the Catechism, followed the latter, and subsequently there appeared a similar volume, "Recent Improvements in the Steam Engine," which

brought the subject down to a comparatively late date.

His more valuable work, however, is his "Treatise on the Steam Engine," known as the "Artisans' Club edition"—a work of very extended design, and, considering its cost, it reached a large sale. It is a quarto volume, finely and copiously illustrated with plate engravings, still it is now somewhat behind the times, and has been to some extent superseded by other more recent treatises. Another work of Mr. Bourne's, similar in scope to this just mentioned, and in fact quite recently finally completed, is upon "Steam, Air and Gas Engines." It is a bulky, quarto volume, handsomely illustrated, and on all form of motors, other than of steam, is very replete and late. A series of similar treatises, projected on the plan of Bourne's, is that of Mr. N. P. Burgh, an English engineer, and published within the past ten years. They embrace now quite a number of volumes, and it is not important that I enumerate them. Suffice to say that Burgh is an able, practical engineer and a good draughtsman, apparently, and from some standpoints his works are valuable. The drawings in one of his largest books, a treatise on "Modern Marine Engineering," with the continuation on "Compound Engines," are excellent, and being drawn to scale from actual examples are made particularly valuable.

The only special fault to be noted in Mr. Burgh is his failure to be clear at times in his language, or always comprehensible. We have, in this country, a writer somewhat similar to Burgh, in so far as the very practical character of the two are concerned. I refer to Stephen Roper, of Philadelphia. He has issued a number of volumes. A "Catechism," a treatise on "Boilers," one on the "Locomotive," another on the "Steam Fire Engine," and so on. They are all, perhaps, commonplace manuals, with little in them that is strictly new, but are written from a practical view alone, in plain, possibly homely, language, but they meet the case exactly of the wants of many workmen, because they are plain and practical. A book of quite different character from these, but appealing as well to our workmen, is another American book, Forney's "Catechism of the Locomotive." Mr. Forney, one of the editors of the *Railroad Gazette*, New York, has adopted Bourne's plan of questions and answers which seems so popular, but, aside from this, few writers have a better command of the pen than he, and none a more happy facility of telling all there is to tell in a clear, concise way. His book has had a large sale, has been turned into nearly all languages, and, I understand also, being translated into one of the Indian dialects for the use of Her Majesty's subjects in the British Indian Empire.

Another American work which has had a large sale upon its merits, is a "Treatise on the Slide Valve," by Wm. S. Auchincloss, of Philadelphia. I think I may safely say that there is no other work on this subject that is the equal of this. Though partly only purely practical, at the same time is not of too theoretical a character to be in the least abstruse, and it has everywhere, I believe, a reputation accorded to but few American books in this branch of science.

As representative English writers I cannot well pass by such men as Humber or Fairbairn.

The former of these is best known, perhaps, by his great work on "Iron Bridge Construction;" a very elaborate and expensively gotten-up treatise in two quarto volumes. It is probably as expensive a book as we have in English, and while the sale of it on account of its price ($60) must necessarily be small, yet quite a number of copies of it have been sold here. In elegance of the plates illustrating this and the other works of Mr. Humber, namely, "Records of Modern Engineering," 4 vols., 4to, and "Water Supply for Cities and Towns," one large volume, also quarto, few other books in our language can compete. They should be seen and examined to be appreciated. As for the text, of course Mr. Humber's record as an engineer is sufficient guarantee for its excellence. I may add here that the last named of these books, the "Water Supply," was reproduced in this country—pirated, our English friends would say—and this American edition compares very favorably with the original, and is sold at less than half the price of it. Mr. Fairbairn's volumes are much less expensively produced than Humber's. His "Useful Information for Engineers," in three small volumes, is a work in high estimation, and a portion of his treatise on "Mills and Mill Work" has been reprinted here under the title of "Machinery of Transmission."

In comparison with the volumes of Humber we have in this country few to present that are produced on quite so lavish a scale. Yet we do have many excellent scientific books, so far as paper and printing can go toward producing handsome volumes. One of these is the quarto, but rather unpretentious work, of Jas. B. Francis, on the "Lowell Hydraulic Experiments." It is true, the copper plates in this volume were engraved in Paris at a heavy expense, but they could have been done equally as well in this country. The tables, an important portion of the book, as well as forming a considerable amount of the subject matter, were carefully read, re-read and compared, so as to be, as it is believed they are, absolutely perfect. Another and more pretentious work than this, and of much more elaborate character, is one on "Long Span Bridges," by the late John A. Roebling, who met his death in the initial stages of our great East River bridge. No expense was spared in the preparation of this handsome folio volume, and while it may not be accorded a place with the best known works on engineering science, yet it is by every one regarded one which exhibits the American principle of the suspension railway bridge by a master mind. A later work than any of these named, and of quite recent issue, is a "Treatise on Steam Boilers," by Chief Engineer Shock, U. S. Navy.

Considering the short time this work has been for sale, it has met with remarkable success. So far as beauty of typography, handsome paper, and well executed plates, may go towards making a fine volume, this will at least bear comparison with books in most any branch of science. It appeals, no doubt, in subject to every workman in the machine shop, and the only possible drawback to it that I can note is that the cost of it may to some extent prevent many workmen who feel like possessing it from purchasing. In order to give you an idea how much is invested in a work of this kind, in the engraving of the illustrations, the making of the stereotype plates, the printing, papers and binding of the first 500 copies, I would state that this particular book represents an outlay of some $5,000 to $6,000. The royalty or the copyright paid to the author is *not* estimated in this, as that is a factor that is embodied into the cost only as the book is sold, and therefore is not part of the expense of production. Perhaps I am dwelling too long in details of a minor interest, but if we even so much as attempt to touch on each book of a representative character, we are well nigh lost in the multiplicity of names that present themselves to our mind, and English and American books represent but a small part of the number, in the infinity, I might say, of scientific literature. The German and French books form a legion by themselves, and in elaborate character, whether in wealth of engravings, bulk of matter and beauty of print, the French and German modern scientific books far exceed all others; and if we could divest them of the increased cost of importation, that is the attendant expense of getting them here and the added duties, they would, as a rule, be models of cheapness. Of course, they come here mostly in paper covers, but then the item of cloth binding is but a trifle. A very great improvement has been made in the past few years, especially by the Germans, in the typography of scientific books, and both they and the French are producing elaborate and beautiful volumes upon all manner of subjects in science. I would mention here that a few years ago a beautiful volume upon American construction was issued in Paris, namely, "Malezieux Travaux Publique des Etats Unis," and to add that no such book in this, our own country, has ever been or is likely ever to appear, in which the details either in text or plates, descriptive of our bridges, railroads, canals, steamboats, etc., etc., could be given with the care and exactness, regardless of expense, exhibited in this unique production.

For general treatment of the large range of subjects in mechanical engineering, we would briefly refer to the various Proceedings of the different societies here and abroad. Among them the volumes of the Institute of Mechanical Engineers, Birmingham, England, stands unrivalled. We know of but one set in this city, and this is in the Library of the Cooper Union reading room. Another set is in the Mechanics Institute of San Francisco, and we believe these two are the only complete sets in this country. There are various other societies in England whose published Proceedings are valuable, such as those of the Institution of Civil Engineers, and the Society of Engineers, both of London. The late Zerah Colburn, of this country, was President of this latter society for many years. Many sets of the former society's Proceedings are in different libraries of this country, but we believe there is but one complete set in this country, which is in the School of Mines library, Columbia College. The principal American society is that of the Civil Engineers. Their papers are printed monthly, for the use of the members, but are obtainable by others at a moderate cost. The papers of the Institute of Civil Engineers, London, are, however, only obtainable by the members, and in this way those who are desirous of having them in a printed form, for preservation and reference, are forced to become members of the society. There are numerous similar societies throughout Europe, but it is hardly within our province to enumerate them here.

Regarding the publishing houses of scientific books, I would state that in England two only confine themselves exclusively to this line, *i. e.*, E. & F. N. Spon, and Crosby, Lockwood & Co. Many other houses, as in this country, publish various works in science of all kinds and are heavy publishers as well, such as Longmans & Co., London, or Appleton & Co., New York, but Spon and Lockwood confine themselves now to science only, and the former house deal mostly in engineering and the allied sciences. Lockwood are now the publishers of Weale's series, and many other important and elaborate books. In Paris, Mallet Bachelier, Lacroix & Dunod are the leading houses, the former, successors to Gautier-Villars, deal mostly in mathematical books and the latter mainly in engineering, architectural and hydraulic works. Recently they have issued an exhaustive series on engineering in all branches, Dubauve's Manuel de l' Ingéneur, in 20 volumes, octavo and 12 quarto atlases of plates. Dumain, of Paris, confines himself to military literature exclusively. In this country the leading publishers in science alone are H. C. Baird & Co., of Philadelphia, and Van Nostrand and John Wiley & Sons, of this city. The former house publishes books of an exclusively practical nature, or, as they term it, "industrial science." Van Nostrand, on the other hand, has more of the theoretical class on his list, and also combines with these military and naval science. The Messrs. Wiley have never confined themselves solely to science. They are possibly doing so more of late, but still they deal in some miscellaneous literature as well as in biblical.

Large numbers of publishers, however, throughout the country are turning their attention to works in science, and the number of books issued is increasing year by year. The proportion of scientific works published in this country, however, to the whole number, in other branches of literature, is relatively small, and, in comparison as well to what the German and French are giving to the world, would seem quite insignificant. In closing these remarks I would like to say that, now that the apprentice system has been virtually abandoned, young men who are learning a trade have to depend largely upon their own studiousness to become proficient in their line of work. To this end these books of which I have been speaking are the essential helps, and I really think that with the array of volumes presented, little excuse exists for any conscientious workman to remain in ignorance of the requirements of the trade of his choice, or to fail to attain a fair proficiency in it.

MEXICAN NEWS.

CITY OF MEXICO, March 10; via Havana, March 17.—Work has begun on the Jalapa & San Andrea Chalchicomula Railroad. The two termini of the road will eventually be the City of Mexico and Vera Cruz. The railroad fever is high, and a great many Americans are in the capital.

ENGINEERING IN FOREIGN LANDS.

(Translated and prepared for ENGINEERING NEWS).

The Engineers' Club has now been definitely constituted in Rio Janeiro. The initiation fee is $10, the annual fees $6. Senor Niemeyer has given the free use of his house for the club, and the privilege of a telephone.

Colonel William Milnor Roberts, who was commissioned by the Brazilian government to report on some of the harbors to the north of Rio Janeiro has written an interesting letter to the *Revista de Engenharia*. The ports of Pernambuco, Ceara and Maranhao, and the port of the city of Aracaju were then more particularly selected. He left on Sept. 29, on board the *Espirito Santo*, and examined the port of Pernambuco. Ceara he considers as a virgin port for the engineer, where there is much room for improvement. While at Maranhao he took the opportunity of visiting the canal at Arapapahy. He was everywhere treated with the greatest hospitality. The same paper also contains the first part of the report of the Colonel on the improvement of the Rio de S. Francisco.

American engineering works continue to form a

prominent feature in the discussions of our friends across the Atlantic. Herr Bruestlein lectured before the Basle engineers on elevated railways, and on other peculiar and remarkable undertakings.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Altoona is to have a new reservoir for its water-works. Seven acres near the present reservoir have been purchased by the authorities as a site for the new basin.

Extensive surveys are being made in Ashland relative to an additional water supply for Boston, and surveys will also soon be made in Marlboro for a supply basin.

Committees have been appointed in Sing Sing (N. Y.), to consult an engineer in regard to two sources of natural supply of pure water, the cost of land damages, etc., and to ascertain the probable cost of pipes, laying the same, and the cost of valves.

The forthcoming report of the Northampton (Mass.), water-works shows that during the year there has been an extension of 742 feet of six-inch pipe, so that there are now more than 22 miles of water-mains in the town. The total cost of construction so far is $210,757.

The maximum daily consumption of water in Providence, R. I., during the summer of 1880 was upward of seven millions of gallons; it is found necessary to increase the pumping capacity, and the Board of Public Works of that city are now discussing the subject of an additional engine.

On the 15th a petition was presented to the Board of Aldermen of this city, by several firms, calling attention to the danger to life and health from the inhalation of poisonous gases emitted by the new process of manufacturing gas, known as the water-gas system, now used by the Municipal and New York gaslight companies. It was referred to the proper committee.

It has been decided by the Salem (Pa.) City Council to build water-works. In the meantime a committee has visited a number of cities and conferred with civil engineers. It is proposed to get the supply three miles distant, and the Holly plan is likely to be adopted. The contract will be given early and the works, it is confidently expected, will be completed by August 1 of this year.

The committee on villages sitting at Albany (N. Y.) has the Lansingburgh water bill under consideration. Mr. Charles H. Fisher spoke in its favor. He said it was necessary for the village of Lansingburgh to have a supply of water; that the proposed amendments of the act would authorize the village trustees to make an agreement with a water company to be formed for that purpose; that the capital required for laying of mains, etc., would be from $25,000 to $30,000; that the water board of the city of Troy had been authorized to supply the village with water.

BRIDGES.

The scheme for the construction of a bridge across the Delaware River, from Philadelphia to Camden, will have to secure first the consent of the legislatures of New Jersey and Pennsylvania.

The proposed bridge over the Ohio at New Albany will be located at the south end of Vincennes street, and cross over Sand Island with a single span over the steamboat channel between the Indiana and Kentucky shore, landing on the Kentucky side of Thirty-second street, in the Portland suburb of Louisville. The capital stock of the company is $1,500,000, and the estimated cost of the bridge $1,200,000. The bridge will be 9,550 feet in length. In addition to a railroad track, it will have tracks for wagons, street cars and footmen. All the surveys and estimates have already been made, and work will be commenced, it is stated, in May. The company is organized under a special act of the Kentucky and Indiana legislatures. Two companies were organized, but they have been consolidated. The span over the steamboat channel on the Kentucky side will be so high as not to interfere with steamboat navigation.

RIVERS AND HARBORS.

A dispatch says the Kansas River has risen and flooded part of Kansas City, Mo.

RAILROADS.

A Dallas (Tex.) dispatch says that a letter has been received from President Hale, stating that twenty-five miles of the Chicago, Texas & Mexican Central Railroad had been let for construction.

Friday's *Railroad Gazette* records the construction of 54½ miles of new railroad, making 254 miles reported thus far this year, against 575 miles reported at the same time in 1880, and 141 miles in 1879.

The stockholders of the Philadelphia & Chester County Railroad Co. held a meeting recently, when it was decided to prosecute to completion the public works authorized by their charter. It was also agreed to begin active work upon the extension and completion of their road.

The Minneapolis & St. Cloud Railroad has been consolidated with the Mankato & St. Cloud Railroad. The new organization is called the St. Cloud, Mankato & Austin Railroad Company. The capital stock is $2,000,000. The new stock will be issued to stockholders on the 19th inst.

The old Missisquoi & Clyde River Railroad Company has been reorganized by the mortgage bondholders under the name of the Newport & Richmond Railroad Company. This road extends from Newport, Vt., to the Canadian line, twenty miles, and forms the connection between the Passumpsic & Southeastern Railroad.

A new line of railroad is to be built from Mechanicsville to Schenectady. It will cross the Mohawk at between three and four miles from Schenectady. A substantial iron bridge, one of the finest in that part of the State, will be built. It will be 1,000 feet long. Engineers have been locating piers and approaches during the last week.

Several hundred teams and men are working on the grade of the Denver, Western & Pacific Railway, between Denver and Longmont. Contracts for bridges have been let and work is being vigorously pushed. The report that work on the Denver, Utah & Western branch had been commenced was premature, there having been nothing done yet.

A corps of engineers have arrived in Blairville, Pa. They immediately went to work locating the low grade division of the West Penn. between Blairville and Bolivar. The road will run up on the east bank of the Connemaugh, and cross the river in the vicinity of Bolivar. Another corps of engineers are at work in the neighborhood of Lockport. It is stated they are of the Baltimore & Ohio road.

The Atchison, Topeka and Santa Fe has made connection at Tucson, Arizona. There were present R. R. Coleman, Manager of Construction; A. C. Longstreet, of the Southern Pacific; J. H. Bates and J. F. Kilaba, of the same, and others. The silver spike was driven at 3.45 by the above-named gentlemen. Engineer O'Neil, of engine 503, A., T. and S. F., was the first engine from Atchison to the Southern Pacific Road.

An Elkhart (Ind.) dispatch says a proposition was made the Cincinnati, Wabash & Michigan Railway, on the 11th inst., to extend its road to Benton Harbor from Goshen. The officers of the road are now considering the proposition, and there is a probability of its being accepted. Should this project go favorably the company will run a line of steamers between Milwaukee and Benton Harbor, making a direct connection from Milwaukee to the extreme south.

A Jerseyville (Ill.) dispatch says: "The construction of the St. Louis, Jerseyville & Springfield Railroad was contracted March 11, except the Tunnel Division—about six miles at the river. There were thirty-two bidders. Mr. B. D. Haines, of Brattleboro, Vt., was awarded the earthwork, and S. Bothwell & Co., of this city, the timber work. The line, as located, connects with the great lines at Springfield, goes through Bates, Loami, Waverley, Vancil's Point, Palmyra and Chesterfield, goes one mile north of Medora, passes through Fidelity and Jerseyville to the river to Grafton, probably via Elsah, where the bluff will have to be tunneled about 900 feet. The maximum grade of the road will be 46 ft., and only 40 ft., excepting the Tunnel Division. The road-bed between Jerseyville and Springfield is to be completed by Aug. 1, next, and between Jerseyville and the Tunnel Division by Sept. 1, and the Tunnel Division ready Oct. 1, 1881. The contract for the Tunnel Division will be contracted next Saturday. The management of the road, as far as known at present, is in the hands of James A. Locke, President; Hugh N. Cross, Vice-President; Morris R. Locke, Secretary; Andrew W. Cross, Treasurer; William H. Fulkerson, General Manager; Executive Committee, James A. Locke, Edward P. Leonard and Wallace Leigh."

An Omaha dispatch gives the following information concerning railroads to be built in Nebraska during this year: "The Sioux City & Pacific Railroad will extend its Elkhorn Valley branch another hundred miles beyond Neligh to Long Pine, and in further contingencies will push on fifty miles further to Fort Niobrara. This same road will iron the line now graded from Norfolk to Creighton, a distance of thirty-five miles, and will probably push on to Niobrara City, at the mouth of the river of the same name. On the extreme north the Chicago, Milwaukee & St. Paul has made aggressive advances, and is now running trains to Running Water, on the Dakota side of the Missouri River opposite Niobrara City, and is making arrangements to push an extension westward toward the source of the Niobrara River, with the ultimate probable intention of building a line to the Big Horn and Powder River regions in Northern Wyoming. The St. Paul & Omaha line is a new competitor for Nebraska business. It is the Nebraska division of the old St. Paul & Sioux City Railroad, this road having gained control of the Omaha & Northern Nebraska Railroad and the Covington, Columbus & Black Hills Narrow-Gauge Railroad. The former was fifty miles long, with an extension under way. The latter was a corporation, with thirty miles in operation. The Omaha & Northern Nebraska road, under the new management, has been extended to Sioux City. The narrow gauge has been made standard width, and trains are running from Sioux City to Ponca. This corporation has laid out construction work for 100 miles. The line has been located and graders' stakes have been set up for a branch from a point north of Oakland to Norfolk, there connecting with the Omaha, Niobrara & Black Hills Branch of the Union Pacific and the Sioux City and Pacific lines to Neligh and Creighton respectively. In addition, it is expected that the iron will be laid on an extension west from Ponca, through Dixon and Cedar counties, toward Creighton or Niobrara. Each of these proposed extensions will be fifty miles in length. The Burlington & Missouri Co. bought one Nebraska road last year (the Atchison & Nebraska Railroad), and constructed something like 100 miles in the Republican Valley. In addition to the extension of the Valley line to Denver, and perhaps through the mountains westward beyond that city, work is now progressing on a line connecting Endicott, a junction station on the St. Joseph & Western Division of the Union Pacific, and Republican Valley branch of the Burlington & Missouri, eastward to Table Rock, on the Atchison & Nebraska line, and probably east of that point to the Missouri River. The proposed extension of this company in Nebraska will require 100 miles of iron."

NEW PROJECTS.

The Dominion and Quebec governments have agreed to establish a railway ferry across the St. Lawrence River at Quebec.

A dispatch from Ottawa, Canada, dated the 15th, stated that bill incorporating the European and Canadian Cable Company had been passed.

The Denver, Colorado Springs & Pueblo Railroad Company filed articles of incorporation on the 17th. The capital stock is placed at $3,000,000, divided into 30,000 shares. The object is to build a broad-gauge road from Pueblo by way of Colorado Springs to Denver.

ALBANY, March 17.—The following filed articles of corporation to-day: The Prall Super-Heated Water Company of Brooklyn, with a capital of $2,000,000. The New York, Pennsylvania & Western Railroad Company; capital, $2,000,000. The route commences near the State line of New York and Pennsylvania, and runs to Buffalo through Allegany, Cattaraugus, Wyoming and Erie counties. The Iron and Bullion Furnace Company of New York, with a capital of $2,500,000.

COUNCIL BLUFFS, Iowa, March 15.—The articles of incorporation of the "Union Elevator Company," with a capital of $500,000, have been filed in this city. The company is to erect mammoth grain elevators in Council Bluffs to meet the demands of grain buyers and shippers on the seven railroads terminating here. The incorporators are Sidney Dillon, Union Pacific Railroad; A. L. Hopkins, Wabash; A. Keep, Chicago & Northwestern; Hugh Riddle, Chicago, Rock Island & Pacific; and C. E. Perkins, Chicago, Burlington & Quincy roads.

Articles of incorporation have been filed with the Colorado Secretary of State by the Longmont, Middle Park & Pacific Narrow-Gauge Railroad Company. The incorporators are James M. Warren, Edward F. Lamb and George L. Warren, of Denver; capital, $2,000,000, with 200,000 shares at $10 each. The line is designed to operate in the counties of Boulder, Grand, Routt, Summit and Gunnison, the road to commence at Longmont, extend through the Park by Hot Sulphur Springs and on to a point on Green River. The directors for the first year are James M. Warren, Edward F. Lamb, F. C. Beckwith, George L. Warren and James M. Dennis.

Articles of incorporation of the Chicago & Dakota Railway Company were filed in the office of the Secretary of State of Minnesota, March 11. The proposed line, as set down in the articles of incorporation, is to start from a point on the Winona & St. Peter Railroad at or near Tracey Station, Lyon County, thence in a westerly direction to the State line, in the county of Lincoln. The general offices of the company are to be located in Winona. The capital stock is fixed at $300,000, divided into 3,000 shares of $100 each. Five per cent. is to be paid in at the time of subscription, and the remainder in installments as ordered by the Board of Directors, not exceeding 25 per cent at any one time. Exclusive of mortgages, the highest indebtedness allowed to be incurred shall be $200,000. A board of five directors shall be elected annually on the first Thursday in June—the first board being Marvin Hughitt, of Chicago; Thomas Wilson and S. Sanborn, of Winona, and M. M. Kirkman, and J. B. Redfield, of Chicago. Until their successors shall be elected Marvin Hughitt shall be president, J. B. Redfield vice-president and secretary, S. Sanborn assistant secretary, and M. M. Kirkman, treasurer.

A company was formed on the 11th, in Brooklyn, to promote rapid transit by an underground route. The stockholders met in Everett Hall, in Fulton street, for organization and discussion. The new company will be known as the Brooklyn Underground Railroad Company. The capital stock is $1,000,000, of which 10 per cent. is paid in. The following board of thirteen directors was chosen: J. M. Leavitt, George Wilson, Eugene D. Berri, Henry Mumford, T. K. Horton, O. B. Baldwin, J. L. Nutting, William Burdon, Edward Freel, John French, B. T. Lynch, I. F. Cary and J. M. Balch. The main line of the proposed route extends from the Sands street end of the East River bridge to the Willink entrance of Prospect Park, at Flatbush avenue and Malbone street, Flatbush, where it will connect with the Prospect Park, Flatbush & Coney Island road, the end of which is at Brighton Beach. It is proposed to make a tunnel under Washington street to Fulton street, then under that street with a curve near the Court-house to Flatbush avenue, thence under the whole length of that avenue in Brooklyn and partly outside the city line to Malbone street, Flatbush. It is also planned to have branches under Myrtle avenue to Broadway, Atlantic avenue to East New York, and Fourth avenue to Bay Ridge. The estimated cost is about a million of dollars a mile, and the road will be built under the Railroad Act of 1880. This provides for the consent of the owners of one-half of the property on the line of the road, and the appointment of a Supreme Court Commission to appraise damages. Plans for the new road are being prepared by Samuel McElroy, the engineer of the company.